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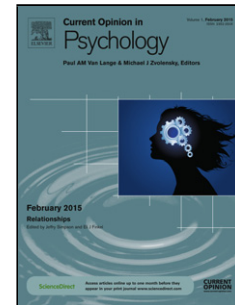
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Neighborhoods, psychological distress, and the quest for causality

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Highlights

- Neighborhoods may influence psychological distress but evidence for causality is mixed
- Causality has been examined by intervention, longitudinal, and twin studies
- Overall evidence suggests only limited support for causal neighborhood associations with psychological distress

Abstract

Neighborhood characteristics have been associated with psychological distress, but it is uncertain whether these associations are causal. The current article reviews data from interventions and quasi-experimental studies that have addressed the question of causality of neighborhood associations. Overall, data from neighborhood interventions, longitudinal studies, and twin studies have provided only limited and inconsistent evidence to support causal interpretation of neighborhood associations with psychological distress: very few findings have been replicated across different samples, and many associations have been observed only with some of the multiple measures included the studies. Studies that examine the effects of neighborhood change on people's wellbeing are needed to improve causal inference and policy relevance of neighborhood studies.

Keywords: Neighborhood; Depression; Longitudinal; Causal; Twin studies

Introduction

Metropolitan city centers, sparsely populated suburbs, remote rural towns, and other residential locations differ from each other in many aspects. Some neighborhoods have plenty of recreational opportunities, other have high crime rates; some invest in new bike lanes and urban amenities, others cannot attract money to cover pot holes; some attract young singles who soon move away, others are inhabited by families and retirees who tend to stay longer. It is reasonable to hypothesize that such differences in residential characteristics influence people's mental health and wellbeing [1–3].

Dozens of studies have linked neighborhood characteristics with residents' mental health problems, including depression, schizophrenia, and antisocial behaviors [4]. These associations are commonly labelled as *neighborhood effects*, but often the label promises too much; the majority of neighborhood studies have been cross-sectional, which makes it impossible to exclude the alternative explanation of selective residential mobility [5]. People with poorer mental health may, on average, end up living in different neighborhoods than those without mental health problems [2,6]. This could be caused directly by mental health problems (e.g., lower motivation to move, difficulties in deciding where to move) or indirectly by factors that influence both residential mobility and mental health (e.g., lower socioeconomic status constraining mobility options).

Yet it seems plausible that neighborhoods do influence mental health. The current review focuses on studies that have leveraged experimental or quasi-experimental study designs to identify potentially causal neighborhood effects on psychological distress, that is, symptoms of depression, anxiety, and unspecified somatic complaints that tend to co-occur in the general population. To cover the research literature as broadly as possible, I performed a literature search using Scopus database (scopus.com) searching titles, abstracts, and keywords for:

("neighborhood") AND (causal OR longitudinal OR experiment* OR quasi-experiment* OR twin) AND (depress* OR distress OR anxiety). After reviewing the titles and abstracts of 526 documents, I found 15 relevant studies and one review (not

counting all the published articles from some of the individual studies) that formed the core of this review.

Community interventions

In the Moving to Opportunity (MTO) experiment, low-income families in five large U.S. cities were randomized to get housing vouchers that allowed them to move away from high-poverty neighborhoods [7]. This led to lower psychological distress among adult participants in the treatment vs. control group [8], and some mental health benefits were observed even in the long-term follow-up 10 to 15 years after the experiment [9]. A further analysis showed that mental health improved only for those who moved to a more advantaged neighborhood surrounded by other advantaged neighborhoods [10]; an advantaged neighborhood without surrounding advantaged neighborhoods was not sufficient. This is probably because people's living environments extend beyond their immediate residential neighborhoods [11]. Furthermore, some of the mental health benefits of the treatment group were attenuated by more frequent experiences of discrimination that the movers encountered in their new neighborhoods [12].

Instead of moving people away from poor neighborhoods, urban planners might be interested in improving the livability of deprived neighborhoods [13**]. Neighborhood regeneration projects may, among other activities, aim to improve transportation, green areas, or safety; promote physical activity; develop public spaces; or to demolish abandoned buildings to build new housing. These projects can

be used to assess whether improvements in the built environment improve residents' wellbeing. For example, a regeneration project in Wales [14**] compared regeneration vs. control neighborhoods (simultaneously applying propensity score matching to mitigate differences between the residents) and found urban regeneration to have a beneficial effect on residents' psychological distress over a follow-up from 2001 to 2008 (0.02SD difference). However, a systematic review of 14 community intervention studies concluded that there was only weak evidence to support mental health benefits of urban regeneration projects [13]. Only 2 of the 14 reviewed studies reported a small mental health benefit, and crucial methodological limitations were identified in eight of the studies—including the two studies reporting mental health benefits.

Longitudinal studies with fixed-effect regression

Longitudinal studies that measure mental health at multiple time points are an improvement to cross-sectional studies. But if they measure neighborhood characteristics only at baseline they are still subject to similar confounding biases as cross-sectional studies. A better longitudinal study design uses repeated measurements of both neighborhoods and mental health, so that the participants can act as their own controls at different time points, adjusting for all individual characteristics that remain stable over time.

A 10-year study from Australia [15] and a 18-year study from the United Kingdom [16] found no within-individual associations between neighborhood

deprivation and psychological distress. In other words, the same individuals did not have lower psychological distress when they were living in more affluent neighborhoods compared to other times when they were living in more deprived neighborhoods, providing no evidence for causal neighborhood effects.

Neighborhood deprivation was associated with stronger intentions to move away from current location [15,16], showing that the within-individual analysis could identify plausible causal neighborhood effects. In the U.S. Add Health study [17], changes across neighborhood poverty quintiles were not associated with subsequent depression when considering only associations that replicated in all three follow-ups (from waves 1 to 3, waves 3 to 4, and waves 1 to 4).

Two studies examined how changes in the neighborhood were associated with psychological distress in those who remained in the same neighborhood throughout the follow-up period. In a Canadian study [18], an increase in material neighborhood deprivation was associated with increasing psychological distress among non-moving residents (0.15SD difference) whereas decreases in material neighborhood deprivation were not associated with distress. Changes in social neighborhood deprivation were not associated with distress in either direction. The follow-up time was only six years, which is a short time span for substantial neighborhood change. In another study [19], increasing neighborhood crime rates between 2006-2008 and 2009-2010 were associated with increasing psychological distress among non-moving residents (adjusted OR=1.49 for men and OR=2.01 for women when comparing lowest and highest tertiles). The follow-up was short (~3 years), and

neighborhood crime rates were categorized into tertiles. A neighborhood moving from the lowest to the highest crime-rate tertile experienced an increase from ~20 crimes per 1000 residents to 100+ crimes per 1000 residents [19]. Such drastic changes over a short time period may have represented unusual neighborhood circumstances.

Other longitudinal studies have focused on residential greenery or proximity to the sea, which have been associated with wellbeing in several cross-sectional studies [20,21]. In the British Household Panel Survey [22], a 1SD difference in neighborhood greenery was associated with a 0.02SD lower psychological distress in within-individual analysis of movers. In a follow-up study [23], psychological distress decreased among individuals who moved to greener areas, and this decrease was observed up to 3 years after the move (0.02SD difference); there was no change in psychological distress after moving to less green areas. In a third study from the same cohort [24], coastal proximity (<5km versus 5-50km) was associated with 0.05SD lower psychological distress in a within-individual analysis of movers; no association was observed with life satisfaction as the outcome.

In a Swedish study [25] with measurements in 2000, 2005, and 2010, a 1SD increase in the distance to nature was associated with slightly higher odds of psychological distress (OR=1.03, CI=1.00, 1.06, $p=0.08$), and this association remained in the within-individual analysis (OR=1.07, 1.00, 1.14, $p=0.07$). In the German Socioeconomic Panel Study with annual measurements between 2000 and 2012, an increase of each 100m from urban green areas were estimated to decrease

life satisfaction by 1% standard deviation [26]. There were no associations with proximity to forests or waters, so the observed associations were specific to urban parks but not proximity to nature in general.

Twin studies

Twin studies can adjust for confounding that arises due to genetic and environmental influences that have made siblings more similar to each other. Three studies from the Washington State Twin Registry have examined neighborhood associations with mental health. The first [27*] reported that neighborhood deprivation was not associated with depression after the shared genetic and environmental factors of twin pairs were taken into account (0.10SD vs. 0.035SD difference per 1SD difference in deprivation). Another study from the same sample with the same indicators of neighborhood deprivation and depression [28] concluded that neighborhood deprivation was similarly associated with depression scores in the within-twin (IRR=1.11 higher rate of depression symptoms per 1SD difference in deprivation) and the between-twin (IRR=1.13) analysis, suggesting no familial confounding. Two other neighborhood characteristics—residential instability and income inequality—were associated with depression in phenotypic models but not in the within-twin models. It is unclear why these two studies produced different conclusions.

In the third study [29], the associations of neighborhood greenery were observed in the within-MZ analysis when predicting depression (0.03SD difference per 1SD

difference in greenery) and stress (0.06SD difference per 1SD difference in greenery), suggesting no familial confounding. There was no within-twin association when predicting anxiety. While cross-sectional twin studies are useful in accounting for genetic and shared environmental confounding, they cannot establish temporal ordering of the associations. Thus, the within-twin pair associations could also arise via genetically influenced selective residential mobility, as both neighborhood characteristics and residential mobility are partly heritable [30].

Conclusions

In an ideal situation, evidence from different study designs, samples, and methods would converge to a common conclusion when weighting all the available evidence for causality [31]. In the case of neighborhood effects, the causal evidence has not yet converged to robust conclusions [5,32]. The overall evidence from different types of studies of psychological distress is not particularly strong, but some of the results from experimental and quasi-experimental study designs do suggest possible small effects. There are several methodological issues that need to be considered when evaluating the totality of evidence up to date.

Some of the reported associations have worked only in one direction. For example, moving to greener areas was reported to improve mental health but moving to a less green area was not associated with worsening mental health [22]. While such direction-specific effects are possible, a general causal framework [33] would lead one to expect reversibility: in the absence of strong theoretical arguments and

multiple empirical replications of direction-specific associations, one would assume worsening neighborhood conditions to increase distress, and improving neighborhood conditions to decrease distress.

In many studies, associations have been observed only with some, but not all, of the neighborhood or distress measures included in the study. For example, associations have been observed with proximity to urban parks but not to forests [26]; with material but not social neighborhood deprivation [18]; or with psychological distress but not life satisfaction [24]. This weakens the overall evidence because there seems to be no good explanations why the causal associations would be observed only with the specific measures. A systematic comparison of different measures across multiple studies could provide a clearer picture of the most promising causal effects between specific neighborhood characteristics and mental-health outcomes. Moreover, most of the reported associations have been small in magnitude. Even small causal effects may be relevant for population mental health if the specific neighborhood risk factor is common enough in the population. However, none of the studies reviewed above have attempted to estimate the potential population consequences of the reported neighborhood effects.

There is a need for more rigorous studies that focus on *neighborhood change* as the primary causal variable [32]. If the results from neighborhood studies are to guide policies that improve people's mental health and wellbeing, such policies are likely to be implemented as changes in the built environment—planning land use, designing urban spaces, or preserving natural environments. Studies of neighborhood change

could be community interventions or quasi-experimental studies of naturally occurring neighborhood changes that develop over long time periods (e.g., neighborhood gentrification) or happen quickly (e.g., introduction of a new recreational space). As noted by the review of urban regeneration projects to date [13**], the current evidence base for community intervention studies is rather weak. In addition to the focus of neighborhood change, it may be equally important to consider the long-term stability of people's neighborhoods across the life span and even generations: neighborhoods may influence health trajectories that begin already early [34–36] in life even if changes in adult neighborhoods would not have marked effects on health changes [15,16,37].

This review focused on psychological distress of individuals, which is only one of the relevant outcome measures to consider when assessing neighborhood effects. Other psychosocial or behavioral outcomes may be more sensitive to causal neighborhood effects. For example, evidence from quasi-experimental urban regeneration projects suggests more robust effects in reducing violence than in improving mental health [38]. This might be expected, as the occurrence of criminal behavior is more directly dependent on the physical and social structures of specific locations. On the other hand, associations between neighborhood deprivation and other mental health outcomes, such as schizophrenia, seem to represent selective residential mobility instead of causal neighborhood effects [39,40*].

In sum, there is only limited evidence to suggest that neighborhood characteristics are causal risk factors for psychological distress. The supporting

evidence is not completely absent, but the few associations that have been reported still wait for direct replications in different samples or conceptual replications with similar measures. A focus on neighborhood change over time, and systematic comparison between different measures of neighborhoods and mental health, could provide valuable new data for evaluating the neighborhood characteristics as causal risk factors for psychological distress.

Conflict of interest statement: Nothing declared

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